PATTERNS OF FIREFIGHTER FIREGROUND INJURIES

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National Fire Protection Association
Fire Analysis and Research Division

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Abstract

For the 2003-2006 period, there was an estimated annual average of 40,270 firefighter fireground injuries in the U.S. Of these, an average of 29,710 were minor, and 10,560 were moderate or severe.

The leading types of minor injuries were: strain or sprain accounting for an annual average of 7,035 injuries or (24%); pain only, accounting for 3,345 injuries (12%); thermal burns only, accounting for 3,415 injuries (11%); cut or laceration, accounting for 2,695 injuries (9%).

The leading types of moderate and severe injuries were: strains or sprain accounting for an annual average of 3,635 injuries a year, or 34%; thermal burn, accounting for 940 injuries (9%); pain only, accounting for 920 injuries (9%).

Activities related to extinguishing a fire accounted for most of the minor injuries (15,400 or 52%), and for most of the moderate and severe injuries (5,470 or 51%).

The leading causes of minor injuries were exposure to something (6,670, or 23%), while for moderate and severe injuries the leading cause of injuries were fell, slipped, or tripped (3,095 or 29%).

Keywords: firefighter fireground injuries, primary apparent symptom, type of activity while injured, age of injured firefighter, time of day, improving firefighter safety.

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We are also grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS.

For more information about the National Fire Protection Association, visit www.nfpa.org or call 617-770-3000. To learn more about the One-Stop Data Shop go to www.nfpa.org/osds or call 617-984-7443.

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Introduction

An analysis of firefighter injury data from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) was undertaken to examine factors that are beyond the scope of results based on the NFPA survey. Results were analyzed for the 2003-2006 period. This is the NFPA's second firefighter fireground injury report since data was collected based on NFIRS 5.0. National estimates of firefighter injuries for selected breakdowns are based on data from the NFPA survey used in conjunction with NFIRS.

Severity of injury was broken into two groups:

- minor (includes report only, first aid only, and treated by physician not a lost-time injury)
- moderate and severe (includes lost time injuries where there was little danger of death or permanent disability, and time lost injuries when there was a potentially life-threatening condition. Because of the small number of severe injuries they were combined with the moderate injuries.

For the 2003-2006 period, there was an estimated annual average of 40,270 firefighter fireground injuries in the U.S. Of these, an average of 29,710 were minor, and 10,560 were moderate or severe (See Table 1).

Primary Apparent Symptom

Because minor injuries outnumber moderate and severe injuries by a factor of 2-to-1, they will dominate the results listed in the total column (Tables 2 to 5), and therefore the summary results in the text were not done separately for total injuries, because it would have been redundant of minor injury results.

For the 2003-2006 period for minor injuries at structure fires, there were an estimated annual average of 7,325 strain or sprain a year, or 25% of all minor injuries (Table 2). Other leading types of minor injuries were: pain only, accounting for 3,455 injuries (12%); thermal burns only, accounting for 3,415 injuries (11%); cut or laceration, accounting for 2,695 injuries (9%); exhaustion or fatigue, accounting for 1,780 injuries (6%); smoke inhalation, accounting for 1,550 injuries (5%); and contusion, accounting for 1,840 injuries (6%).

Table 1
Firefighter Fireground Injuries
Total and by Severity, 2003-2006

Year	Total Injuries	Minor	Moderate and Severe
2003	38,045	9,575	9,575
2004	36,800	9,890	9.890
2005	41,950	10,905	10,905
2006	44,210	11,865	11,865
2003-06 Average	40,270	29,710	10,560

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Table 2
Fireground Injuries by Primary Apparent Symptom for Total Injuries and by Severity, 2003-2006 Annual Average

Primary Apparent Symptom	Total Injuries		Minor		Moderate & Severe	
Sprain or strain	10,960	27%	7,325	25%	3,635	34%
Pain only	4,375	11%	3,455	12%	920	9%
Thermal burns only	4,355	11%	3,415	11%	940	9%
Cut or laceration	3,335	8%	2,695	9%	640	6%
Contusion	2,345	6%	1,840	6%	505	5%
Exhaustion or fatigue including heat exhaustion	2,330	6%	1,780	6%	550	5%
Smoke inhalation	1,875	5%	1,550	5%	325	3%
Puncture wound	890	2%	760	3%	130	1%
Breathing difficulty or shortness of breath	930	2%	670	2%	260	2%
Inhalation of hazardous fumes	655	2%	620	2%	35	0%
Eye trauma	720	2%	615	2%	105	1%
Swelling	810	2%	585	2%	225	2%
Burn or scald	660	2%	540	2%	120	1%
Abrasion	540	1%	500	2%	40	0%
Dizziness, fainting, or weakness	640	2%	425	1%	215	2%
Dehydration	400	1%	310	1%	90	1%
Cardiac symptoms	500	1%	250	1%	250	2%
Fracture	750	2%	175	1%	575	5%
Electric shock	215	1%	165	1%	50	0%
Nausea	190	0%	155	1%	35	0%
Crushing	260	1%	150	1%	110	1%
Foreign body obstruction	150	0%	130	0%	20	0%
Burns and smoke inhalation	220	1%	115	0%	105	1%
Dislocation	315	1%	105	0%	210	2%
Numbness	150	0%	90	0%	60	1%
Other	1,700	4%	1,290	4%	410	4%
Total	40,270	100%	29,710	100%	10,560	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums due to rounding.

Source: National estimates based on 2003-06 NFIRS and NFPA survey.

For the 2003-2006 period for moderate and severe injuries at structure fires there was an annual average of 3,635 strains and sprains a year, or 34% of all severe and moderate injuries (Table 2). Other leading types of moderate and severe injuries were: thermal burn, accounting for 940 injuries (9%); pain only, accounting for 920 injuries (9%); cut or laceration accounting for 640 injuries (6%) fracture, accounting for 575 injuries (5%); exhaustion or fatigue, accounting for 550 injuries (5%); contusion, accounting for 505 injuries (5%); smoke inhalation, accounting for 325 injuries (3%); and breathing difficulty, accounting for 260 injuries (2%).

Primary Apparent Symptom by Part of Body Injured

For the 2003-2006 period, the most common injuries received by firefighters at the fireground occurred in the arm or hand, 8,115 injuries or 20%, and leg or foot, 8,095 injuries or 20%. These were followed by the trunk area, 5095 or 15%, the head area 5,680 or 14%, and the neck or shoulder area, 4,930 or 12%. (Table 3).

Firefighters who suffered burn injuries received them most frequently to the head area (36%), the arm or hand (29%), the neck and shoulder area (18%), and the leg or foot (9%).

For firefighters who suffered from smoke inhalation, not surprisingly, 1,920 or 78% of the injuries were of an internal nature.

Firefighters who suffered from wounds, cuts, bleeding most often received injuries to the arm or hand (64%), the head area (18%), and the leg or foot (14%).

Firefighters who suffered dislocations, fractures experience them most frequently to the arm or hand (28%), the leg or foot (26%), and the head area (14%).

Strains and sprains occurred most frequently to the leg or foot (37%), the trunk area (26%), and the neck or shoulder (18%).

Table 3
Fireground Injuries by Primary Apparent Symptom and by Part of Body, 2003-2006 Annual Average

Part of Body	Total		Burns		Smoke Inhalation		Wound, Cut, Bleeding		Abrasions Dislocations		Strains		Other	
Head	5,680	14%	1,860	36%	110	4%	775	18%	565	14%	35	0%	2,250	17%
Neck or shoulders	4,930	12%	915	18%	65	3%	20	0%	445	11%	2,015	18%	1,470	11%
Trunk area	5,905	15%	140	3%	230	9%	25	1%	425	11%	2,895	26%	2,145	16%
Arm or hand	8,115	20%	1,480	29%	0	0%	2,720	64%	1,115	28%	1,280	12%	1,640	12%
Leg or foot	8,095	20%	450	9%	10	0%	580	14%	1,050	26%	4,105	37%	1,965	15%
Internal	3,340	8%	0	0%	1,920	76%	0	0%	10	0%	10	0%	1,520	11%
Multiple parts	3,380	8%	225	4%	110	4%	70	2%	280	7%	525	5%	2,015	15%
Other	825	2%	60	1%	75	3%	40	1%	75	2%	120	1%	435	3%
Total	40,270		5,135		2,520		4,225		3,965		10,980		13,445	

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Type of Activity at Time of Injury

For the 2003-2006 period for minor injuries, an estimated annual average of 15,400 injuries, or 52% of all minor injuries, occurred at structure fires during activities related to extinguishing a fire (Table 4). Of these, 11,835 occurred while handling hose lines, and 2,950 while using hand tools. Suppression support activities, which include overhaul operations, ventilation, salvage operations, and forcible entry, accounted for an annual average of 7,810 injuries, or 26%. Other incident scene activities, which include laying hose and moving tools or equipment, accounted for 2,630 injuries, or 9%.

Also for the 2003-2006 period for moderate or severe firefighter fireground injuries, an estimated annual average of 5,470 injuries, or 51% of all moderate or severe injuries, occurred at structure fires during activities related to extinguishing a fire (Table 4). Of these, 4,325 occurred while handling charged hose lines. An annual average of 2,565 injuries, or 25 %, occurred during suppression support activities, an average of 950 occurred during other incident scene activities, and an average of 380 occurred during rescue activities.

Table 4
Fireground Injuries by Activity at Time of Injury for Total Injuries and by Severity, 2003-2006 Annual Average

Activity	Total Injuries		Minor		Moderate & Severe	
Extinguish Fire or Neutralize Incident	20,870	52%	15,400	52%	5,470	51%
Handling charged hose line	16,160	40%	11,835	40%	4,325	41%
Using hand tool	3,925	10%	2,950	10%	975	9%
Using hand extinguisher	300	1%	250	1%	50	1%
Operating master stream device	225	1%	170	1%	55	1%
Other	260	1%	195	1%	65	1%
Suppression Support	10,375	26%	7,810	26%	2,565	25%
Overhaul	5,675	14%	4,360	15%	1,315	13%
Ventilation with hand tools	1,865	5%	1,325	5%	540	5%
Salvage	835	2%	530	2%	305	3%
Forcible entry	935	2%	815	3%	120	1%
Ventilation with power tools	1,065	3%	780	3%	285	3%
Other	65	0%	0	0%	65	1%
Other Incident Scene Activity	3,580	9%	2,630	9%	950	9%
Picking up tools, hose or equipment	1,160	3%	850	3%	310	3%
Moving tools or equipment	1,020	3%	750	3%	270	3%
Laying hose	795	2%	550	2%	245	2%
Catching hydrant	345	1%	250	1%	95	1%
Other	260	1%	230	1%	30	0%
Access or Egress	1,275	3%	895	3%	380	4%
Climbing ladder	510	1%	355	1%	155	2%
Raising ground ladder	250	1%	190	1%	60	2%
Carrying ground ladder	175	0%	115	0%	60	0%
Escaping fire or hazard	190	0%	120	0%	70	0%
Other	150	0%	115	0%	35	0%
EMS or Rescue	1,225	3%	855	3%	370	1%
Searching for victim	655	2%	435	2%	220	1%
Rescuing fire victim	410	1%	290	1%	120	1%
Other	160	0%	130	0%	30	0%
Operating Fire Department Apparatus	990	2%	710	2%	280	3%
Engine or pumper	840	2%	605	2%	235	2%
Aerial ladder or elevating platform	120	0%	75	0%	45	0%
Other	30	0%	30	0%	0	0%
Other	1,955	5%	1,410	3%	545	5%
Total	40,270		29,710		10,560	

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums due to rounding.

Source: National estimates based on 2003-06 NFIRS and NFPA survey.

Cause of Injury

Minor firefighter fireground injuries were examined by cause of injury for the 2003-2006 period (Table 5). Overall, an estimated annual average of 6,670, or 23%, were the result of exposure to something, while an annual average of 6,610, or 22%, were injured as the result of overexertion or strain. Other major causes of injury were the result of contact with or being struck, accounting for an annual average of 6,280 injuries, or 21%, and fell, tripped, or slipped, accounting for an annual 5,620 injuries, or 19%.

The 23% of minor injuries that were the result of exposure to something included 3% that occurred due to exposure to heat or flame, and another 3% that occurred due to exposure to fumes, gases, or smoke.

The 22% of minor injuries that were the result of overexertion or strain included 9% that occurred while pulling hose, 3% that occurred during overhaul operations, and 2% that occurred while using hand tools during extinguishment activity.

The 21% of minor injuries that were the result of contact with or being struck by something, for the 2003-2006 period, included 2% that occurred due to being struck by or contact with a floor or ceiling, and another 2% due to contact with tools or equipment.

The 19% of minor injuries that were the result of falling, slipping, or tripping included 3% that occurred in each of three instances: on an icy surface, on an uneven surface, and on other slippery or uneven surface.

Moderate and severe firefighter fireground injuries were also examined by cause for the 2003-2006 period (also Table 5). Overall, an estimated annual average of 3,095 injuries, or 29%, were the result of falling, tripping, or slipping, while an annual average of 2,625

Injuries or 25%, occurred due to overexertion or strain. Other major causes of injury were contact with or being, struck by something, accounting for an annual average of 1,990 injuries, or 17%, and exposure to something, accounting for an annual average of 1,535 injuries, or 15%.

The 29% of moderate and severe injuries that were the result of falling, slipping, or tripping included 5% on an uneven surface, 4% on an icy surface, and another 4% on other slippery or uneven surface.

The 25% of moderate and severe injuries that were the result of overexertion or strain included 10% while handling hose, 4% during overhaul operations, and 3% while using hand tools during extinguishment operations.

The 17% of moderate and severe injuries that were the result of contact with or being struck by something included 2% including a floor or ceiling, and another 2% including tools or equipment.

The 15% of moderate and severe injuries that were the result of exposure to something included 3% due to heat or flame, and 2% due to fumes, gases or smoke.

Table 5
Fireground Injuries by Cause of Injury for
Total Injuries and by Severity, 2003-2006 Annual Average

Cause of Injury	Total Injuries		Minor		Moderate & Severe	
Exposure to	8,205	20%	6,670	23%	1,535	15%
Heat or flame	1,125	3%	770	3%	355	3%
Fumes, gases or smoke	910	2%	750	3%	160	2%
Asbestos	410	1%	400	1%	10	0%
Embers	390	1%	330	1%	60	1%
Steam	425	1%	360	1%	65	1%
Dirt, stones or debris	215	1%	180	1%	35	0%
Floor or ceiling	170	0%	130	0%	40	0%
Chemicals	400	1%	380	1%	20	0%
Structural component, other	85	0%	75	0%	10	0%
Electricity	135	0%	95	0%	40	0%
Charged hose	120	0%	85	0%	35	0%
Glass	120	0%	95	0%	25	0%
Other	995	2%	780	1%	215	2%
Unknown	2,705	7%	2,240	8%	465	4%
Contact with or struck by	8,270	21%	6,280	21%	1,990	17%
Floor or ceiling	910	2%	680	2%	230	2%
Tools or equipment	875	2%	680	2%	195	2%
Nails	495	1%	450	2%	45	0%
Other structural component	645	2%	485	2%	160	2%
Glass	550	1%	420	1%	130	1%
Window	520	1%	380	1%	140	1%
Charged hose	390	1%	260	1%	130	1%
Property or structure contents	325	1%	245	1%	80	1%
Door in building	305	1%	235	1%	70	1%
Coupling	315	1%	225	1%	90	1%
Dirt, stones, or debris	270	1%	220	1%	50	0%
Hot metal	135	0%	110	0%	25	0%
Embers	170	0%	145	1%	25	0%
Wall	215	1%	140	1%	75	1%
Roof	235	1%	180	1%	55	1%
Department vehicle or apparatus	195	0%	170	1%	25	0%
Ground ladder	180	0%	130	0%	50	0%
Uncharged hose	150	0%	125	0%	25	0%
Other	1,250	3%	860	2%	390	4%
Unknown	140	0%	140	1%	0	0%
Overexertion	9,235	23%	6,610	22%	2,625	25%
While handling hose line	3,780	9%	2,690	9%	1,090	10%
During overhaul operation	1,410	4%	990	3%	420	4%
While using hand tools in Extinguishment activity	960	2%	695	2%	265	3%

Table 5
Fireground Injuries by Cause of Injury for
Total Injuries and by Severity, 2003-2006 Annual Average, (Continued)

Cause of Injury	Total Injuries		Minor		Moderate & Severe	
During ventilation operation with hand tools	445	1%	335	1%	110	1%
During ventilation operation with power tools	395	1%	270	1%	125	1%
During salvage operation	155	0%	130	0%	25	0%
Picking up tools, equipment or hose on scene	310	1%	220	1%	90	1%
During forcible entry activity	260	1%	210	1%	50	0%
Laying hose	200	0%	145	0%	55	0%
Moving tools or equipment	185	0%	125	0%	60	1%
Duriung rescue activity	120	0%	70	0%	50	1%
While operating engine or Pumper	150	0%	105	0%	45	0%
Other	860	2%	625	2%	235	2%
Fell, tripped or slipped	8,715	22%	5,620	19%	3,095	29%
Icy surface	1,315	3%	905	3%	410	4%
Uneven surface	1,290	3%	750	3%	540	5%
Other slippery or uneven surface	1,310	3%	870	3%	440	4%
Wet surface	645	2%	410	1%	235	2%
Loose material on surface	515	1%	340	1%	175	2%
Fire Progress, including smoke Condition	450	1%	300	1%	150	1%
Floor collapse	365	1%	215	1%	150	1%
Hole burned through floor	320	1%	200	1%	120	1%
Other holes	390	1%	255	1%	135	1%
Unguarded hole	145	0%	95	0%	50	0%
Stair collapse	105	0%	55	0%	50	0%
Other	1,340	3%	860	2%	480	5%
Unknown	525	1%	365	1%	160	2%
Other	5,860	15%	4,540	15%	1,320	13%
Total	40,270		29,710		10,560	

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums due to rounding.

Source: National estimates based on 2003-06 NFIRS and NFPA survey.

Severity of Injury for Injury Factors

The results for injury factors for fireground injuries presented earlier in Tables 2 to 5 summarized results separately for minor and moderate or severe injuries, that is, within each category what were the major injury factors (e.g., strains and sprains accounted for 25% of minor injuries). Another way to look at the data is given a certain primary apparent symptom category, e.g., sprains and strains is the injury more likely to have been a minor injury or a moderate or severe injury? In other words, some measure of relative risk of the severity of injury for a given primary apparent symptom, a given age group, a certain region of the country, etc. This section examines fireground injuries further to answer some of those questions.

For the 2003-2006 period, severity of injury for selected primary apparent symptom categories was examined (Table 6). This section for minor injuries includes first aid only, and injuries treated by a physician and not a lost-time injury. For smoke inhalation, burns only, cut or laceration, puncture or wound, abrasion, eye trauma, exhaustion and fatigue, and other, most of the injuries (70% to 86%) were minor injuries. On the other hand, for burns and smoke inhalation, dislocation, fracture, strain or sprain, crushing, cardiac like symptoms, most of the injuries (57% to 83%) were moderate or severe injuries. The low percent of cardiac symptoms injuries that were moderate or severe injuries (57%) reflects that many of those injuries probably involved chest pains, but did not involve heart ailments.

For the 2003-2006 period, severity of injury for overall activity categories at time of injury was examined (Table 7). Activities involving extinguishing fire or neutralizing agent (60%), and suppression support (62%), had a similar percent of injuries that were minor. On the other hand, access or egress activities resulted in 44% to 49% that were moderate or severe injuries. Access or egress activities that account for the high occurrence of moderate or severe injuries include activities like carrying or raising a ground ladder, climbing a ladder, and escaping fire/hazard.

For the 2003-2006 period, severity of injury for overall causes of injury was examined (Table 8). For categories exposure to hazard and contact with or struck by object 67% to 74% of the injuries were minor. For overexertion or strain a higher percent of injuries were moderate or severe (46%), and an even higher percent of injuries caused by fell, slipped, tripped (57%) were moderate or severe. In the latter case, firefighters are particularly vulnerable and falls and slips can lead to fractures, dislocations, and severe strains.

For the 2003-2006 period, severity of injury for age of injured was examined (Table 9). Results clearly indicate and not surprisingly that younger firefighters 16 to 19, and 20 to 29 had more minor injuries, while older firefighters age groups 30 to 39, 40 to 49, 50 to 59, and 60 and over, tended to have a higher occurrence of moderate or severe injuries (39% to 43%).

For the 2003-2006 percent, region of the country by severity of injury was examined (Table 10). For the Midwest and South, 65% of the firefighter injuries were minor. The Northeast (42%) and the South (40%) had higher occurrences of moderate or severe injuries. The high occurrence of firefighter injuries in the Northeast has been well documented in the Annual NFPA Firefighter Injury Report.

Table 6.
Severity of Injury for Selected Primary Apparent Symptom Categories, 2003-2006

Primary Apparent Symptom	Minor	Moderate & Severe	Total
Smoke Inhalation	70%	30%	100%
Breathing difficulty	64%	36%	100%
Burns & smoke inhalation	43%	57%	100%
Burns only, thermal	70%	30%	100%
Cut or laceration	76%	24%	100%
Puncture, wound	81%	19%	100%
Contusion	64%	36%	100%
Abrasion	86%	14%	100%
Dislocation	24%	76%	100%
Fracture	17%	83%	100%
Strain or sprain	42%	58%	100%
Swelling	52%	48%	100%
Crushing	43%	57%	100%
Cardiac Symptoms	43%	57%	100%
Eye trauma	79%	21%	100%
Dizziness, fainting, or weakness	60%	40%	100%
Exhaustion or fatigue	71%	29%	100%
Pain only	54%	46%	100%
Other	64%	36%	100%
Total	60%	40%	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Totals may not equal sums because of rounding.
Results were found, based on a Chi-Square test to be statistically significant at the .001 level.

Note in this analysis minor injuries includes first aid only, and injuries treated by a physician and not a lost-time injury.

Source: NFIRS and NFPA survey.

Table 7.
Severity of Injury for Overall Activity Categories
at Time of Injury, 2003-2006

Type of Activity	Minor	Moderate & Severe	Total
Operating Apparatus	56%	44%	100%
Extinguishing fire or neutralizing agent	60%	40%	100% 100%
Suppression support	62%	38%	100%
Access or egress activity	51%	49%	100%
EMS or rescue activity	55%	45%	100%
Other incident activity	54%	46%	100%

Table 8.
Severity of Injury for Overall Causes of Injury, 2003-2006

Cause of Injury	Minor	Moderate & Severe	Total
Fell, slipped, trapped	43%	57%	100%
Exposure to hazard	70%	30%	100%
Contact with, struck by	67%	33%	100%
Overexertion, strain	54%	46%	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Totals may not equal sums because of rounding.
Results were found, based on a Chi-Square test to be statistically significant at the .001 level.

Note in this analysis minor injuries includes first aid only, and injuries treated by a physician and not a lost-time injury.

Source: NFIRS and NFPA survey.

Table 9.
Severity of Injury for Age of Injured, 2003-06

Age of Injured	Minor	Moderate & Severe	Total
16-19	79%	21%	100%
20-29	72%	28%	100%
30-39	61%	39%	100%
40-49	57%	43%	100%
50-59	56%	44%	100%
60 and over	61%	39%	100%

Table 10.
Severity of Injury by Region of the Country, 2003-2006

Region	Minor	Moderate & Severe	Total
Northeast	58%	42%	100%
Midwest	65%	35%	100%
South	65%	35%	100%
West	60%	40%	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Totals may not equal sums because of rounding.
Results were found, based on a Chi-Square test to be statistically significant at the .001 level.

Note in this analysis minor injuries includes first aid only, and injuries treated by a physician and not a lost-time injury.

Source: NFIRS and NFPA survey.

Patterns of Structure Fires by Occupancy and Structure Status

In 2003-2006 fires in residential structures accounted for about eight out of ten firefighter fireground injuries in structures (Table 11). This was in large part due to the large portion, 405,300 or 78%, of all structure fires that are residential fires. When differences in fire occurrence by occupancy are taken into account, results are quite different. The highest firefighter fireground injury rates per 100 fires by occupancy occurred in industry, utility, and manufacturing properties (11.9); store and office properties (8.4); and public assembly properties (7.5).

The rate for residential structures (6.8) was low in comparison to those occupancies, but higher than for storage properties, and for educational properties, and institutional properties. Within residential properties, the rate per 100 fires was 7.0 for 1 & 2 family dwellings, and 5.8 for apartments.

In 2003-2006, most fire ground injuries, 27,785 injuries or 81% , occurred in structures that were occupied and operating (Table 12). Another 2,450 injuries or 7% occurred in vacant and secured structures, while 2,090 or 6% occurred in vacant and unsecured structures.

Table 11
Structure Fires, Fireground Injuries and Injury Rates
By Occupancy, 2003-2006 Annual Average

Occupancy	Structure fires		Fireground Injuries		Fireground Injuries per 100 fires
Public assembly	13,500	3%	1,015	3%	7.5
Educational	6,600	1%	280	1%	4.2
Institutional	7,100	1%	135	0%	1.9
Residential	405,300	78%	27,600	80%	6.8
1 & 2 Family Dwellings	297,500	57%	20,930	61%	7.0
Apartments	92,800	18%	5,400	16%	5.8
Stores &offices	22,900	4%	1,925	6%	8.4
Industrial, utility, manufacturing	11,600	2%	1,375	4%	11.9
Storage	30,800	6%	1,885	5%	6.1
Special	22,400	4%	225	1%	1.0
Total Structures	520,200		34,450		6.6

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

Table 12
Fireground Injuries by Structure Status
Annual Average 2003-2006

Structure Status	Fireground Injuries	
Under construction	385	1%
Occupied and operating	27,895	81%
Idle, not routinely used	650	2%
Under major renovation	520	2%
Vacant and secured	2,450	7%
Vacant and unsecured	2,090	6%
Being demolished	100	0%
Other	360	1%
Total	34,450	100%

Note: These are national estimates of fires and firefighter injuries reported to U.S. municipal fire departments and so exclude fires and firefighter injury reported only to federal or state agencies or industrial fire brigades. National estimates of total fireground injuries are made based on data reported by fire departments to the NFPA in its Annual Fire Experience Survey. Firefighter detailed casualty information is based on data reported by fire departments participating in NFIRS 5.0. Fires are rounded to the nearest hundred, and fireground injuries are rounded to the nearest five.

Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey.

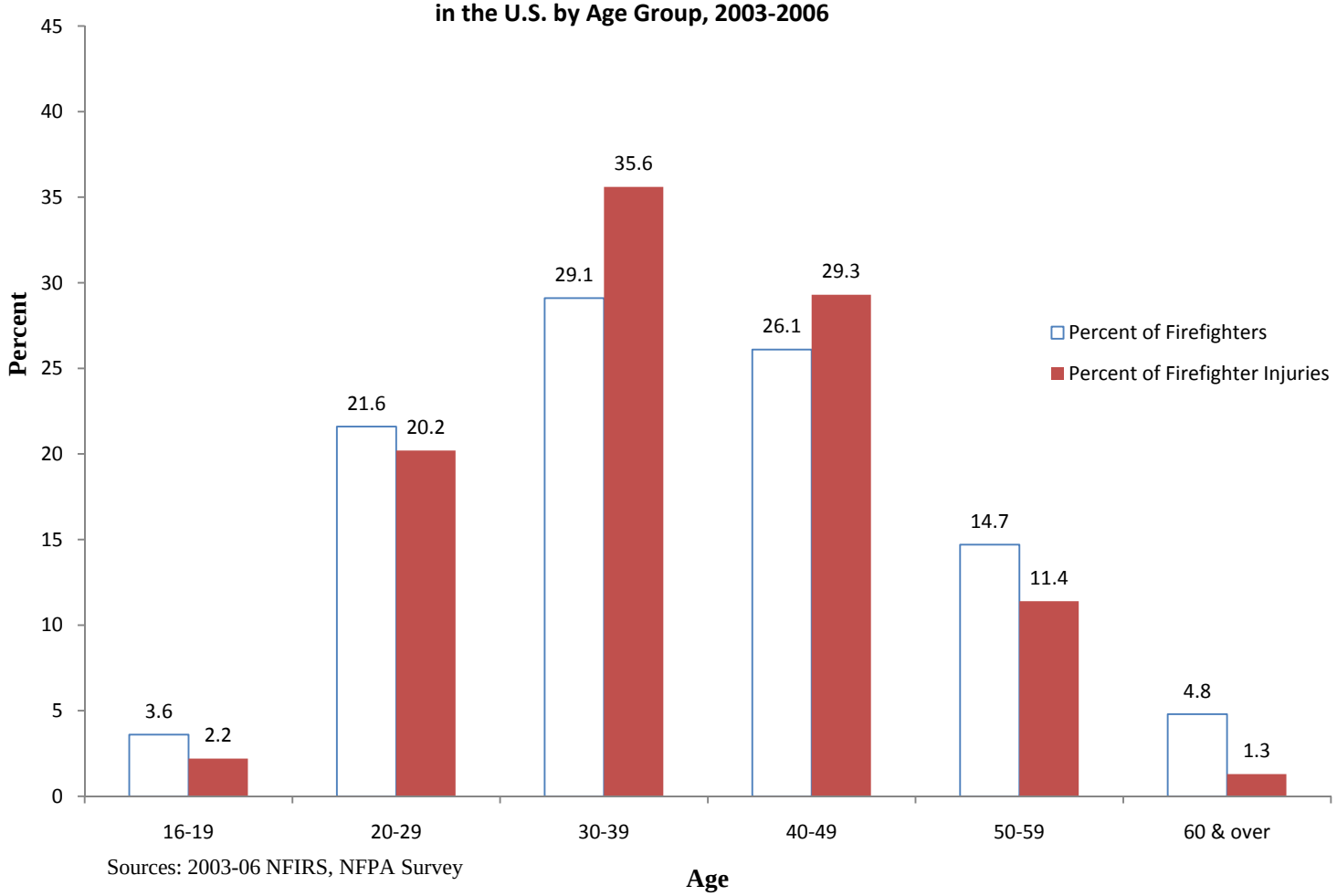
Patterns for Age of Injured, and by Time of Day

For the 2003-2006 period, younger firefighters accounted for the major portion of all firefighter fireground injuries, a result that is very similar to the distribution of firefighters in the U.S. (Figure 1). In all, 54% of firefighters in the U.S. are in the under 40 age group, and they accounted for 58% of firefighter fireground injuries.

The peak periods for structure fires attended by fire departments were noon to 6:00 p.m. (34.7%) and 6:00 p.m. to midnight (28.6%). The smallest share of fires occurred in the early morning hours of midnight to 6:00 a.m. (15.3%) (Figure 2). Firefighter fireground injuries, as one might expect, occurred very often during the peak fire frequency period of noon to 6:00 p.m. (27.3%), but the real surprise was the high occurrence of fireground injuries in the midnight to 6:00 a.m. slot (26.3%), compared to the 15.3% of fires occurring in this time period.

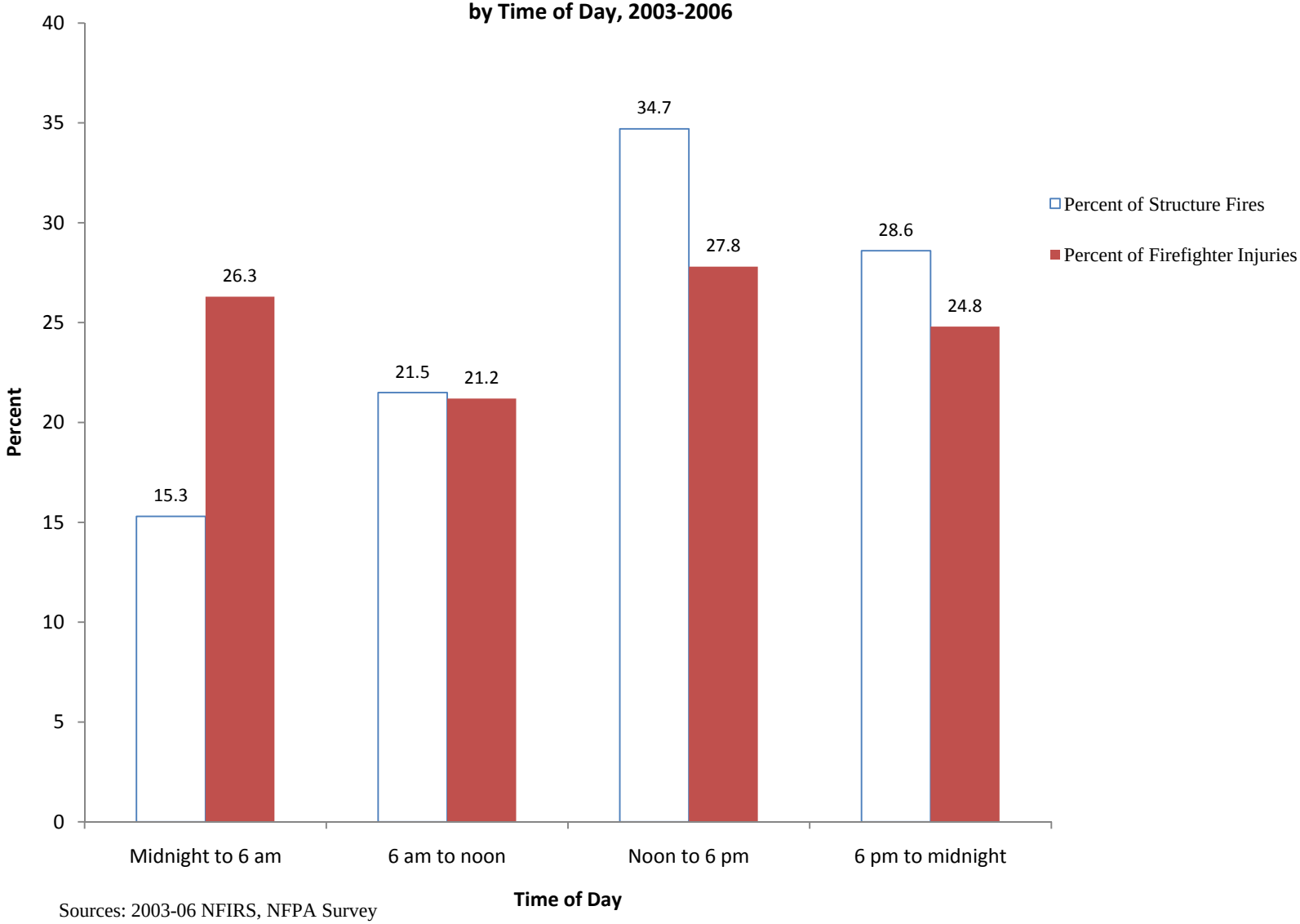
This point is made even clearer when firefighter fireground injuries per 100 structure fires are examined (Figure 3). The highest injury rates per 100 fires occurred in the midnight to 8:00 a.m. time frame, when 9.9 to 14.6 injuries occurred per 100 structure fires attended. Among the factors that may contribute to the high injury rates during the night time hours are lack of visibility, cold temperatures, and lower alertness of firefighters.

Figure 1
Firefighters and Firefighter Injuries in the U.S. by Age Group, 2003-2006



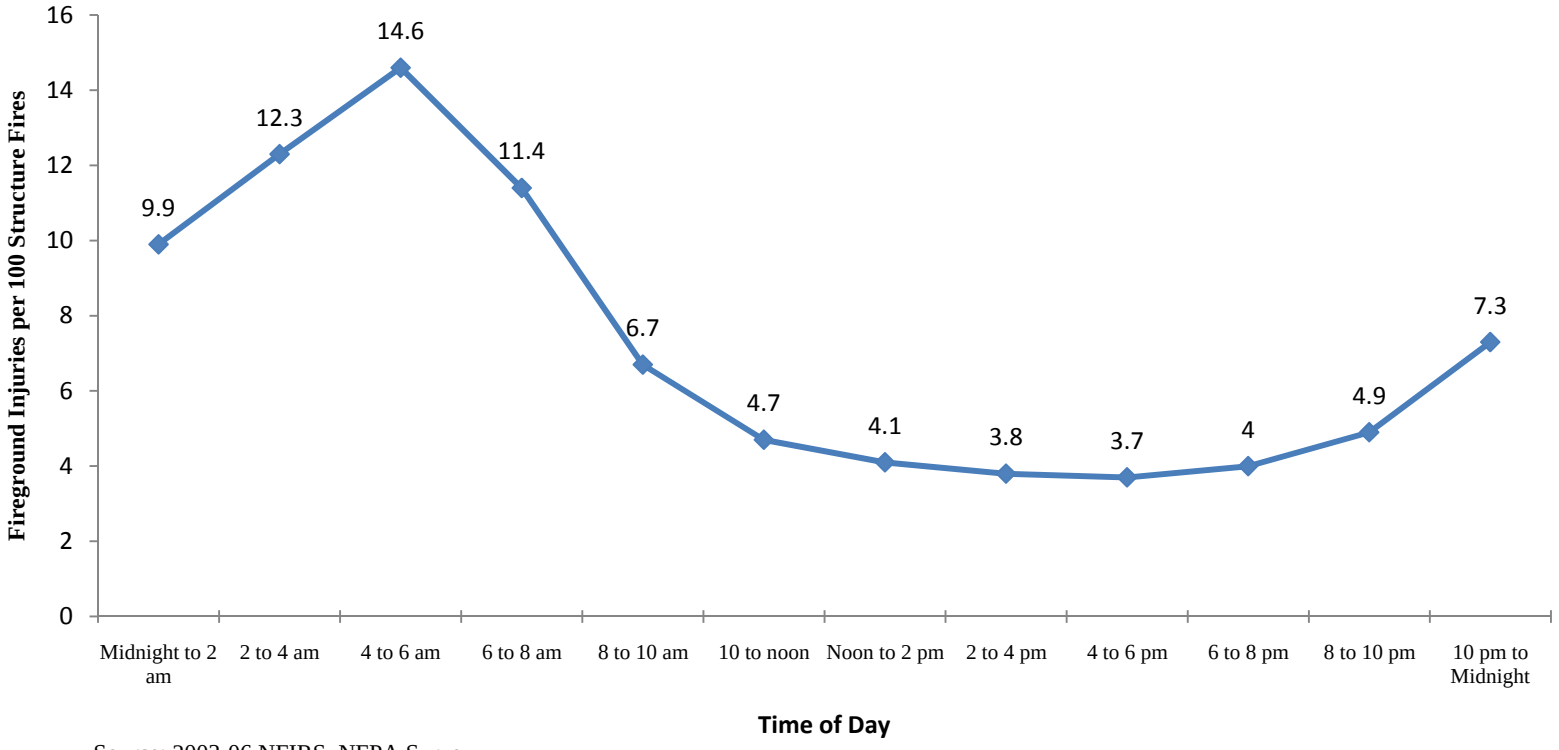
Sources: 2003-06 NFIRS, NFPA Survey

Figure 2
Fires and Firefighter Injuries in Structures by Time of Day, 2003-2006



Sources: 2003-06 NFIRS, NFPA Survey

Figure 3
Firefighter Fireground Injuries per 100 Structure Fire
by Time of Day, 2003-2006



Source: 2003-06 NFIRS, NFPA Survey

Improving Firefighter Safety

As the statistics in this report and previous NFPA annual firefighter injury reports attest, firefighting presents substantial risk of personal injury to firefighters. Moreover, because of the kind of work performed and the hazards of the incident scene environment, it is unlikely that all firefighter injuries can be eliminated. A risk management system and the application of existing technology that is recommended by NFPA be applied at the local level, however, can offer options to reduce present injury levels. There are several examples, with reference to the appropriate *NFPA standard* shown in parentheses:

- Commitment on the part of top fire service management to reducing injuries *(NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, Section 4.3)*
- Establishment of a safety committee headed by a safety officer to recommend a safety policy and the means of implementing it *(NFPA 1500, Section 4.5).*
- Develop and implement an investigation procedure that includes all accidents, near misses, injuries, fatalities, occupational illnesses, and exposures involving members. *(NFPA 1500, 4.4.4 and 4.4.5)*
- Provision of appropriate protective equipment and a mandate to use it. *(NFPA 1500, Section 7.1 through 7.8)*
- Development and enforcement of a program on the use and maintenance of SCBA *(NFPA 1500, Section 7.9 through 7.14*
- Development and enforcement of policies on safe practices for drivers and passengers of fire apparatus *(NFPA 1500, Section 6.2 and 6.3)*
- Development of procedures to ensure response of sufficient personnel for both fire fighting and overhaul *duties*. *(NFPA 1500, 4.1.2; NFPA 1710, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments; and NFPA 1720, Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Volunteer Fire Departments)*
- Implementation of regular medical examinations and a physical fitness program *(NFPA 1500, Section 10.1 through 10.3; NFPA 1582, Standard on Comprehensive Occupational Medical Program for Fire Departments; and NFPA 1583, Standard on Health-Related Fitness Programs for Firefighters)*

- Adoption and implementation of an incident management system.
  (NFPA 1500, Section 8.1; and NFPA 1561, Standard on Emergency Services Incident Management System)
- Training and education for all members related to emergency operations
  (NFPA 1500, Chapter 5)
- Implementation of programs for the installation of private fire protection systems, so that fires are discovered at an earlier stage, exposing the firefighter to a less hostile environment
  (NFPA 1, Uniform Fire Code™; NFPA 101®, Life Safety Code®; NFPA 5000® , Building Construction and Safety Code®)
- Increased efforts in the area of fire safety education programs, so that citizens are made aware of measures to prevent fires and of correct reactions to the fire situation
  (NFPA 1201, Standard for Providing Emergency Services to the Public, Chapter 6)

Efforts need to be made to recognize that firefighter injuries can be reduced. By addressing the priorities listed above, fire service organizations can make significant strides towards reducing the number and impact of such injuries.

Appendix A.
How National Estimates Statistics Are Calculated

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. The strength of NFIRS is that it provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment.

NFPA conducts an annual stratified random sample survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. The NFPA survey is based on a stratified random sample of roughly 3,000 U.S. fire departments (or just over one of every ten fire departments in the country). The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined by the NFPA 901 Standard; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; and (3) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results.

The NFPA survey begins with the NFPA Fire Service Inventory, a computerized file of about 30,000 U.S. fire departments. The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities

protect fewer people per department and are less likely to respond to the survey, so a large number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate. The results of the survey are published in the annual report Fire Loss in the United States. To download a free copy of the report visit http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf.

Projecting NFIRS to National Estimates

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database - the NFPA survey - is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

In this analysis, only data originally collected in NFIRS 5.0 is included in the calculations of the 2003-2006 national estimates for firefighter injuries in structure fires. The portion of fires and firefighter injuries originally collected in NFIRS 5.0 compared to the earlier NFIRS 4.1 version has increased steadily over time. The percent of fires

coded in version 5.0 has increased from 79% in 2003, 88% in 2004, 94% in 2005, and 94% in 2006.

This update for 2003-06 includes injuries that occurred at all fires (incident type 110-171), and at the fireground (where injury occurred codes 5 and 6). The analysis in this report is based on 16,721 injuries that met these criteria. Except for Tables 11, and 12, and Figures 2 to 3, which are for structure fires only, all tables are based on fireground injuries that occurred at all fires. The national annual estimates of firefighter injuries were weighted for the individual years using total fireground injuries from the annual NFPA Fire Experience Survey.

In this report, where data for a factor was unknown, it was assumed to have the same proportional distribution as the distribution where the data was known
The "Other" category includes cases specifically coded as "other" and cases coded in specific categories but with very low frequency.

Note that the number of occurrences for fires has been rounded to the nearest hundred, the number of firefighter fireground injuries has been rounded to the nearest five, whiles percentages are rounded to the nearest whole percent.
Totals in tables may not equal sums due to rounding.